

Tile design test results

Task: study different designs of the ACD scintillating tile for the optimization.

All scintillators tested are 1cm thick, readout by Hamamatsu R1635

1. Fiber spacing effect.

All tiles are BICRON, TYVEK wrapped, multiclاد fibers

Fiber spacing	Light yield, relative units
2 cm	15.9
1 cm	18.1
0.5 cm	22.0
0.25 cm	20.2
Continuous	23.3

2. Wrapping effect

Wrapping	Tile	Relative light yield
TYVEK	BICRON, 5mm fiber spacing, multiclاد fibers	22.0
TETRATEC	---- “ “ ----	24.5
Poliester	---- “ “ ----	20.0
TYVEK	ElJen scintillator, 10mm fiber spacing, single clad fibers	15.3
TETRATEC	---- “ “ ----	17.2

Conclusion – TETRATEC gives ~ 10% of the light yield increase

3. Use of half of fibers (2 PMTs)

All tiles are BICRON, 5mm multiclاد fiber spacing, wrapped in TETRATEC

Number of readout fibers	Relative light yield
All fibers	24.5
Half fibers	11.9

Use of 2 PMTs reduces the light for each PMT by 50%

4. Aluminization of the fiber ends

Fiber ends	Tile	Relative light yield
Razor Cut	TYVEK, ElJen scintillator, 1cm single clad fiber spacing	14.1
Aluminized at GSFC	---- “ “ ----	15.3
Razor Cut	TETRATEC, BICRON, 5 mm multiclاد fiber spacing	24.5
Mylar at the ends	---- “ “ ----	21.1
Razor cut	TYVEK, 1 cm multiclاد fiber spacing	18.1
Aluminized in FNL	---- “ “ ----	21.2

Conclusion – aluminization made at GSFC gives 5-7% of the light increase. Aluminization made in Fermilab, improves the light yield by $\sim 17\%$

5. Fiber cladding

All tiles are EJen scintillator, 1cm fiber spacing, TYVEK wrapped

Fibers	Relative light yield
Single clad	14.1
Multiclad	17.8

Conclusion: cladding is important, gives $\sim 25\%$ of the light increase

6. Scintillator manufacturer

All tiles are 1cm multiclad fiber spacing, TYVEK wrapped

Scintillator	Relative light yield
BICRON	18.1
EJen1	17.8

Conclusion: Difference is within the measurement errors, scintillators perform similarly

7. Other different designs

Tile	Tested feature	Relative light yield
TETRATEC wrapped, BICRON	Light is transmitted to PMT by clear fibers viewing from	5.5

	the tile edge	
BICRON, TYVEK wrapped	Light is collected by WSF glued to both tile edges without spacing	13.2
BICRON, TYVEK wrapped, 1cm multicladd fiber spacing	2 fibers in one groove	19.0 (to compare with 18.1 for one fiber)
BICRON, TYVEK wrapped, 1cm multicladd fiber spacing	Tile is made of 2 5mm thick tiles, fibers are glued between them in grooves cut in one tile	11.0

Design conclusion. It was found that the largest light yield will be provided by the following tile design:

- a) 5 mm fiber spacing
- b) TETRATEC as a wrapping material
- c) Fiber ends are aluminized by the technology developed at Fermilab
- d) Multicladding wave-shifting fibers are used
- e) Scintillator manufacturer (Bicron or ElJen) does not matter much

This design provides 50%-60% of the light increase compared with that obtained for BFEM tile design